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Capacity building on implementation of antimicrobial stewardship (AMS) program and antimicrobial resistance (AMR) surveillance at University Teaching Hospital of Butare (CHUB)

Findings of Baseline Laboratory Assessment of Antibiotic Resistance Testing Capacity (LAARC)

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Executive summary

The Baseline Laboratory Assessment of Antibiotic Resistance Testing Capacity (LAARC) has identified critical gaps affecting the reliability and efficiency of bacteriology services. Key issues include the absence of a contingency plan for uninterrupted services, inadequate autoclave documentation, and insufficient equipment such as CO2 incubators and calibrated loops. The Laboratory Information System (LIS) also shows significant limitations, lacking functionalities for recording AST methods, selective result reporting, and automatic zone interpretation, which undermines the accuracy and integrity of laboratory data.

Furthermore, the assessment highlights deficiencies in quality control oversight, training, and documentation. Supervisors do not review QC results, and there is no evidence of staff training and approval for independent bacteriology testing. Additionally, the preparation of media in contamination-prone areas, the use of human blood from the blood bank for media preparation, and inadequate protocols for specimen processing and storage raise safety and accuracy concerns. Addressing these issues through enhanced equipment, improved LIS capabilities, stringent QC practices, and comprehensive training and SOPs will significantly improve the laboratory's capacity to conduct reliable antibiotic resistance testing and support public health efforts.

The overall score of the laboratory was 55%, indicating substantial room for improvement. Key module scores varied significantly, with high scores in areas such as Specimen Collection, Transport & Management (86%), Data Management (85%), and Safety (82%). However, critical areas such as Quality Control - AST scored 0%, and others like Quality Control - Identification (34%) and AST Panels, Policy and Analysis (16%) were also notably low. These disparities highlight the urgent need for targeted interventions in specific areas to achieve comprehensive improvements across the laboratory's operations

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I. INTRODUCTION

The Baseline Laboratory Assessment of Antibiotic Resistance Testing Capacity (LAARC) aims to evaluate and identify critical gaps in bacteriology services within the laboratory setting. Accurate and reliable antibiotic resistance testing is essential for effective patient care and public health management. This assessment reveals significant deficiencies in contingency planning, equipment availability, documentation practices, and quality control measures. Addressing these gaps is imperative to enhance the laboratory's capability to provide precise and timely diagnostic services, ensuring the efficacy of treatments and contributing to the global effort against antibiotic resistance.

I. 1. Overview of LAARC

The Baseline Laboratory Assessment of Antibiotic Resistance Testing Capacity (LAARC) is a comprehensive evaluation initiative designed to assess the current state of bacteriology services and antibiotic resistance testing in laboratories. This assessment involves a systematic review of laboratory practices, equipment, documentation, and quality control measures. The objective is to identify critical gaps and areas needing improvement to ensure accurate, reliable, and timely diagnostic services. The findings from LAARC provide a detailed overview of the laboratory's capacity to conduct effective antibiotic resistance testing, highlighting deficiencies in contingency planning, equipment usage, training, and protocols, thereby offering a foundation for targeted interventions and improvements.

I. 2. Objectives of the Assessment

1. Evaluate the functionality and performance of microbiology laboratory equipment to ensure its suitability for accurate antibiotic resistance testing.
2. Assess the proficiency and expertise of laboratory personnel in conducting antibiotic resistance testing and adherence to standardized protocols.
3. Identify gaps or deficiencies in quality assurance measures, including documentation, calibration, and proficiency testing, to ensure ISO accreditation standards compliance.
4. Evaluate the efficiency of workflow processes within the microbiology service to optimize turnaround time and resource utilization.
5. Assess the adequacy of data management systems and procedures to ensure accurate recording, storage, and retrieval of antibiotic resistance testing results.

6. Identify opportunities for enhancing training and professional development programs for laboratory staff to stay abreast of advancements in antibiotic resistance testing methodologies.
7. Evaluate the laboratory's communication and collaboration mechanisms with healthcare providers to facilitate timely and accurate reporting of antibiotic resistance profiles.
8. Assess the availability and utilization of advanced technologies, such as molecular methods or automated systems, to improve the accuracy and efficiency of antibiotic resistance testing.
9. Identify areas for improvement in quality control processes, including internal quality control and participation in external quality assessment schemes, to enhance the reliability of testing results.
10. Evaluate the laboratory's capacity to monitor and respond to emerging trends in antibiotic resistance patterns and outbreaks to support effective public health interventions.

I. 3. Scope of the Assessment

The scope of the Baseline Laboratory Assessment of Antibiotic Resistance Testing Capacity (LAARC) focuses on several key categories critical to the performance and reliability of bacteriology services. These categories include the evaluation of facility and equipment to ensure the availability and proper functioning of necessary tools; the Laboratory Information System (LIS) and data management practices for accurate and effective recording and reporting of antibiotic susceptibility testing (AST) results; and quality assurance measures to maintain high standards in laboratory operations. The assessment also examines quality control procedures for media identification and AST, the protocols for specimen collection, transport, and management, as well as the processing techniques used in the laboratory. Additionally, it evaluates basic AST practices and safety measures to ensure a safe working environment.

II. METHODOLOGY

The methodology for conducting the assessment of the microbiology service at the Pathology Department of CHUB using the LAARC tool involved a systematic approach to evaluating various aspects of laboratory operations related to antibiotic resistance testing.

II. 1. Data Collection Methods

The data collection for the Baseline Laboratory Assessment of Antibiotic Resistance Testing Capacity (LAARC) involved conducting on-site visits to microbiology laboratories to observe workflows, equipment usage, and personnel practices firsthand. Structured checklists provided by the LAARC tool were utilized to systematically gather data on various aspects of laboratory operations. These aspects included the functionality of equipment, personnel proficiency, adherence to established protocols, quality control measures, data management systems, and communication processes.

II. 2. Participants Involved

Microbiology Service Manager, a Laboratory Quality Assurance Manager, a Data Manager, and three Microbiologists were involved in the assessment.

II. 3. Criteria and Indicators Assessed

The Laboratory Assessment of Antibiotic Resistance Testing Capacity (LAARC) evaluates multiple critical variables to determine the effectiveness and reliability of bacteriology services. These variables include facility and equipment, which encompass the adequacy of the laboratory infrastructure, availability and maintenance of general and media preparation equipment, temperature and atmosphere monitoring, and inventory management. The Laboratory Information System (LIS) and data management are assessed for their ability to record demographic, specimen, culture observation, and AST data, as well as capabilities in report generation, data transfer, and system connectivity.

Quality assurance measures are reviewed to ensure the laboratory maintains high standards in its operations, including staff education, training, competency, and external quality assessments. Quality control processes are scrutinized for media preparation, biochemical method QC, and AST reference strains, highlighting the use of positive and negative controls, and adherence to QC protocols. The specimen collection, transport, and management category evaluates practices related to specimen handling from various sources, including blood, urine, and stool specimens, ensuring proper procedures are followed to maintain sample integrity.

Processing methods are analyzed for their effectiveness in handling blood, urine, and stool cultures, while identification methods and SOPs are examined for the presence, accessibility, and thoroughness of standard operating

procedures. Basic AST practices are assessed for the maintenance of antibiotic disks, inoculum preparation, and result interpretation. AST expert rules are reviewed for their application to various bacterial pathogens and resistance mechanisms. Additionally, AST panels, policy, and analysis focus on the development of comprehensive panels and cumulative antibiograms. Lastly, safety measures are evaluated, including biosafety equipment, behaviors, personal protective equipment, and documentation and training to ensure a safe working environment.

III. KEY FINDINGS

The overall findings revealed a facility score of 78%, highlighting strengths in laboratory infrastructure and general equipment availability but noting deficiencies in autoclave management (0%) and inventory management (58%). The Laboratory Information System (LIS) was excluded from the overall score but achieved 72%, indicating good demographic and specimen data fields (100% and 88%, respectively) but inadequate AST data fields (25%).

Data management scored 85%, reflecting robust patient and specimen identification (100%) and order entry processes (100%), though culture observations were only partially documented (53%). Quality assurance was significantly lacking, with a score of 49%, due to insufficient staff education, training, and competency (25%). Quality control was particularly problematic, especially in AST (0%) and identification methods (34%), with notable gaps in QC practices for biochemical methods and media.

Specimen collection, transport, and management excelled with a score of 86%, demonstrating effective practices across various specimen types. However, processing practices scored 57%, with weaknesses in blood culture processing (43%). Identification methods and SOPs were critically low at 32%, indicating a need for updated and accessible SOPs. Basic AST practices scored 67%, but interpreting results was notably weak (11%). AST expert rules performed well at 85%, showing proficiency in critical areas like beta-lactam breakpoints and phenotypic testing. However, the policy and analysis of AST panels were insufficient (16%), and safety measures scored 82%, with strong biosafety behaviors but less satisfactory equipment availability (60%).

III. 1. Facility and equipment

The assessment of the laboratory's facility and equipment reveals a well-maintained infrastructure with strong points in several key areas. The laboratory facility itself scored 92%, supported by comprehensive equipment availability (75%) and proper maintenance of media preparation equipment (100%). Essential items such as thermometers (100%) and temperature monitoring systems (92%) are in place and functioning well, ensuring that environmental conditions are consistently recorded (100%) and maintained within defined ranges (100%). However, significant gaps were identified in autoclave management, which scored 0%, and inventory management, which scored 58%. Despite these shortcomings, the overall evaluation indicates that the laboratory has a solid foundation in terms of facility and equipment, with specific areas requiring attention to enhance operational efficiency and reliability.

III. 2. Lab information system and data management

The LIS performs well in capturing demographic (100%) and specimen (88%) data fields, ensuring critical patient and sample information is accurately recorded. However, it falls short in culture observation data fields (60%) and AST data fields (25%), limiting its effectiveness in supporting comprehensive antibiotic susceptibility testing.

Additionally, the LIS demonstrates moderate capabilities in generating reports and data transfer (60%), indicating a need for enhancements to fully integrate data management and streamline laboratory operations.

The findings on AST panels, policy, and analysis indicate significant deficiencies, reflected in a low overall score of 16%. There is an absence of well-defined AST panels (0%), which impedes the standardization of antibiotic susceptibility testing procedures. The poor performance in cumulative antibiograms (17%) suggests the laboratory is not effectively compiling or analyzing this critical data, crucial for tracking resistance patterns. Although the AST panel policy scored slightly better (38%), it still highlights a need for comprehensive policy development and implementation to ensure consistency and reliability in AST practices. These gaps underscore the need for a systematic approach to enhance the laboratory's AST capabilities.

The laboratory demonstrates strong competence in applying AST expert rules, achieving an overall score of 85%. This high score reflects proficiency in applying expert rules for various bacterial pathogens and resistance mechanisms, including Gram negatives and beta-lactam breakpoints (100%), and phenotypic testing for ESBL and carbapenemase (100%). However, there are areas not assessed, such as colistin testing and inducible clindamycin resistance testing, which indicate potential gaps in the comprehensive application of expert rules. Overall, the laboratory shows robust capabilities in utilizing expert rules, although there remains room for further enhancement.

Data management within the laboratory is a notable strength, with an overall score of 85%. The laboratory excels in patient and specimen identification (100%) and order entry (100%), ensuring accurate tracking of samples from receipt to result reporting. The specimen requisition form process is robust (100%), further supporting accurate data capture. However, culture observations documentation (53%) requires improvement to ensure comprehensive data collection. The reporting of AST results is highly effective (100%), and data backup and security measures are strong (83%), safeguarding critical laboratory data. The lack of antimicrobial resistance (AMR) data sharing was not assessed, suggesting an area for future evaluation and development. These findings highlight a well-managed data system with specific areas for improvement to enhance overall data integrity and usability.

III. 3. Quality assurance

The assessment of quality assurance within the laboratory reveals substantial gaps and areas requiring significant improvement, resulting in an overall score of 49%. A critical aspect that needs attention is the quality structure and basics, which scored 45%. This indicates that foundational quality management principles are not fully established or adhered to within the laboratory. One of the most concerning findings is the lack of adequate laboratory staff education, training, and competency programs, which scored only 25%. This deficiency suggests that many staff members may not be properly trained or evaluated to perform their tasks independently and competently, which can compromise the reliability and accuracy of laboratory results.

Furthermore, the laboratory's performance in troubleshooting, problem-solving, and root cause analysis was moderate, with a score of 50%. While some mechanisms for addressing and resolving issues exist, they are not consistently or effectively applied. The external quality assessment (EQA) process fared better with a score of 73%, indicating that the laboratory participates in external evaluations to benchmark its performance against external standards. However, the overall low scores in key areas of quality assurance underscore the need for a more robust and systematic approach to quality management. This includes establishing comprehensive training programs, improving problem-solving processes, and ensuring that quality assurance measures are consistently applied and monitored across all laboratory operations.

III. 4. Quality control – media identification and AST

The quality control of culture media in the laboratory is an area with several significant deficiencies, resulting in an overall score of 43%. Media preparation SOPs scored 67%, indicating that while some standard operating procedures exist, they are not comprehensive or consistently followed. General media preparation practices scored 50%, reflecting inconsistencies in the preparation process. Notably, there is a complete lack of quality control for distilled or deionized water preparation, which scored 0%. This is critical, as the quality of water used can directly impact the reliability of media. Routine media QC scored particularly low at 10%, highlighting a significant gap in regular quality checks to ensure media effectiveness. While Mueller Hinton media preparation and QC showed moderate compliance with a score of 50%, the overall findings suggest a need for stringent quality control measures and regular monitoring to ensure the reliability of culture media used in bacteriology testing.

The quality control of identification methods in the laboratory also revealed several weaknesses, with an overall score of 34%. The quality control of Gram stain reagents and their labeling and storage practices scored relatively well at 75%, indicating good practice in this specific area. However, the QC of individual biochemical methods is notably inadequate, scoring 25%. Positive and negative controls are inconsistently used, with positive controls in use only 57% of the time and negative controls 29%. The performance of QC on each new batch or lot number of reagents is even more concerning, with a score of 14%. Furthermore, the use of ATCC or ATCC-derivative strains for QC scored 0%, showing a critical gap in the standardization and reliability of identification tests. This underscores the need for the implementation of robust QC practices across all identification methods to ensure accurate and reliable results.

The quality control of antibiotic susceptibility testing (AST) in the laboratory is critically lacking, with an overall score of 0%. There are no routine AST reference strains in use, nor are there any special AST reference strains employed for quality control purposes. QC of disc diffusion AST methods is entirely absent, indicating that the laboratory does not perform regular quality checks on these methods to ensure their accuracy and reliability. The absence of QC for

gradient strip AST methods and automated AST systems further emphasizes the critical need for the implementation of comprehensive quality control practices. This complete lack of quality control measures for AST severely undermines the reliability of antibiotic susceptibility testing results, highlighting an urgent need for the establishment and enforcement of stringent QC protocols to ensure accurate and dependable testing outcomes.

III. 5. Specimen collection, transport & management

The assessment of specimen collection, transport, and management reveals a generally strong performance with an overall score of 86%. This high score indicates that the laboratory adheres to many best practices in handling specimens, ensuring their integrity from collection to analysis. The laboratory excelled in specimen management (91%) and specimen rejection practices (94%), demonstrating a thorough approach to maintaining sample quality and proper documentation. The robust procedures for rejecting unsuitable specimens ensure that only viable samples are processed, thereby enhancing the reliability of test results.

Blood specimen collection and transport practices are well-implemented, scoring 85%. This indicates that the laboratory follows stringent protocols to prevent contamination and degradation of blood samples. Urine specimen collection and transport also scored highly at 88%, reflecting consistent adherence to proper collection and handling procedures. However, stool specimen collection and transport practices scored lower at 67%, indicating some gaps in this area. This suggests a need for improvement in the protocols for collecting and transporting stool samples to ensure they remain viable for accurate testing.

Overall, the laboratory demonstrates strong capabilities in managing most types of specimens, ensuring that they are collected, transported, and processed under conditions that preserve their integrity. However, the lower score for stool specimen handling highlights an area where targeted improvements could further enhance the laboratory's performance. Ensuring consistent training and adherence to protocols across all specimen types will help maintain high standards and reliability in diagnostic testing.

III. 6. Processing

The assessment of processing procedures within the laboratory reveals a mixed performance, resulting in an overall score of 57%. While some areas show adherence to best practices, there are notable gaps that require attention to ensure consistent and reliable processing of specimens. Blood culture processing, which is crucial for detecting bloodstream infections, scored relatively low at 43%. This suggests that there may be inefficiencies or inconsistencies in the processing of blood cultures, potentially impacting the accuracy and timeliness of results. Similarly, manual blood culture systems scored 50%, indicating room for improvement in the procedures and protocols surrounding manual processing methods.

Urine culture processing, another essential aspect of bacteriology testing, scored moderately at 43%. While there are protocols in place for urine culture processing, there may be opportunities to streamline workflows and enhance efficiency in this area. However, the laboratory performs well in stool culture processing for Salmonella and Shigella, scoring 88%. This indicates robust procedures for processing stool cultures, ensuring accurate detection of these specific pathogens.

Overall, the findings suggest that while the laboratory demonstrates proficiency in certain aspects of processing, there are areas where improvements can be made to enhance efficiency and accuracy. Strengthening protocols and procedures, particularly in blood culture processing and manual methods, will contribute to a more streamlined workflow and improved reliability of results. Continued monitoring and evaluation of processing practices will be essential to ensure ongoing quality improvement within the laboratory.

III. 7. Basic AST

The assessment of Basic Antibiotic Susceptibility Testing (AST) practices within the laboratory reveals a moderate performance, resulting in an overall score of 67%. Basic AST is a fundamental component of bacteriology testing, and while the laboratory demonstrates proficiency in some areas, there are notable gaps that need addressing. The maintenance of antibiotic disks and gradient strips scored relatively well at 70%, indicating that the laboratory ensures the availability and proper storage of these essential testing materials. Additionally, inoculum preparation, a critical step in AST, scored highly at 89%, suggesting that the laboratory follows established protocols for preparing bacterial inoculums.

However, there are areas where improvement is needed. Inoculation and incubation procedures, which scored 64%, indicate some inconsistencies or deficiencies in these processes. This may affect the accuracy and reliability of AST results. Notably, there are significant weaknesses in interpreting AST results, with a score of only 11%. This suggests that there may be challenges in accurately interpreting the zones of inhibition, which could lead to errors in determining bacterial susceptibility profiles. Breakpoints standards, an essential component of AST interpretation, scored well at 86%, indicating that the laboratory follows recognized standards for interpreting AST results.

Overall, while the laboratory demonstrates proficiency in some aspects of Basic AST, there are areas where improvements can be made to enhance accuracy and reliability. Strengthening procedures for inoculation and incubation and providing additional training on interpreting AST results will be crucial for improving the overall quality of Basic AST practices within the laboratory. Continued monitoring and evaluation of AST procedures will be essential to ensure ongoing adherence to best practices and quality improvement.

III. 8. Safety

The evaluation of safety measures within the laboratory reveals a commendable performance, resulting in an overall score of 82%. Safety is paramount in any laboratory setting, and the laboratory demonstrates a strong commitment to ensuring a safe working environment for its staff. Biosafety equipment, which includes items such as biological safety cabinets and personal protective equipment, scored moderately at 60%. While there may be room for improvement in the availability and maintenance of such equipment, overall compliance with biosafety protocols is satisfactory.

Biosafety behaviors among laboratory staff scored highly at 100%, indicating a strong culture of adherence to safety protocols and procedures. This includes practices such as proper hand hygiene, waste disposal, and decontamination procedures, all of which are essential for minimizing the risk of laboratory-acquired infections. Additionally, the use of personal protective equipment (PPE) is consistently observed, further contributing to a safe working environment.

Documentation and training in biosafety practices scored well at 80%, suggesting that the laboratory provides comprehensive training to staff on safety protocols and procedures. However, there may be opportunities to further enhance documentation practices to ensure that all safety measures are adequately recorded and tracked.

Overall, the findings suggest that the laboratory prioritizes safety and has implemented robust measures to protect the health and well-being of its staff. While there are areas where improvements can be made, such as equipment availability and documentation practices, the laboratory's strong commitment to safety is evident and should be commended. Continued monitoring and evaluation of safety practices will be essential to ensure ongoing compliance with safety standards and protocols.

IV. GAP CLOSING ACTION PLAN

Category	Identified Gap	Actions	Timeline	Responsible	Resources Needed
Facility and equipment	No contingency plan in place to provide uninterrupted bacteriology services	Develop concept for inter laboratory collaboration and sample referrals for microbiology with an MOU draft.	10th – 23rd Jun 2024	Laboratory team (lead) & Research team	Include in ten-day workshop on QMS document development for microbiology
	The record of the Autoclave doesn't demonstrate the mechanical indicators like Pressure, temperature, Chemical indicator, biological indicator, or time of cycle, at each time the autoclave is run	Write SOP on use and maintenance of Autoclave			
	No CO2 Incubator for isolation of strict anaerobes	Procure GasPak Anaerobic System full kit	By 30th June if possible		Reallocate budget for part of Miscellaneous
	No Calibrated 1µL or 10µL loops (for plating urine cultures)	Procure reusable Calibrated 1µL or 10µL loops			
Lab information system, AST panels, policy, analysis interpretation, expert rules and Data management	LIS does not record method used to obtain AST, LIS can't suppress (hide) an individual antibiotic result from the patient report without deleting it from the database (for cascade reporting), only RIS is entered and not inhibition zone and Can't automatically interpret zone sites into Susceptible, intermediate, resistant, no input for descriptive response(morphologies or quantities of colonies, Biochemical test…), expert rules not integrated, antibiotic panels are inconsistent hence extractable data not suitable for a reliable cumulative antibiogram, When corrections to patients results made, erroneous results are deleted from the records	Develop a template for integrating international standards and guidelines for Antimicrobial Susceptibility Testing and Reporting. (Configuration of testing methods, Antibiotic testing panels by isolate by sample type, record of measured DD or MIC, interpretation of measures to RIS based on standard breakpoints and expert rules, extractable cumulative antibiogram, keeping modified results….)	10th – 30th Jun 2024	Dr Mbarushimana Djibril	Reallocate Public Awareness I and part of Miscellaneous budget

Quality assurance	A supervisor or quality officer Does not review media QC, ID QC, and AST QC result	Write an SOPs for quality control of Media. Include Root Cause Analysis, monitoring of corrective actions and reporting modalities to the management of hospital leadership	10th – 23rd Jun 2024		Include in ten-day workshop on QMS document development for microbiology
		Write an SOPs for quality Isolate. Include Root Cause Analysis, monitoring of corrective actions and reporting modalities to the management of hospital leadership			
		Write an SOPs for quality control antibiotic susceptibility testing. Include Root Cause Analysis, monitoring of corrective actions and reporting modalities to the management of hospital leadership			
	Laboratory hasn't up-to-date evidence that staff performing bacteriology testing have been trained on and approved to work independently	Develop training material for standardized bacteriology testing			
		Develop SOP for competence assessment in bacteriology with objective oriented assessment tools			
		Train laboratory staff on standardized bacteriology testing and reporting	24th – 30th Jun 2024		Include in five-day training of Bacteriology Lab Staff on standardized bacteriology testing and reporting
Quality control – media and AST	No media specific SOPs in place for each type of media reconstituted in house	Write SOP on culture media preparation and Storage.	10th – 23rd Jun 2024		Include in ten-day workshop on QMS document development for microbiology
	Media is prepared in the same room where specimens and cultures are processed	Desing workflow for microbiology processes adapted to the CHUB laboratory context			
	Human Blood from blood bank used to make the blood agar, chocolate, and/or MB Plate	Develop acceptable procedure for preparation of blood base culture media based on current scientific knowledge (The optimization of Human Blood Agar (HBA) for Streptococcus pneumonia growth, Modified Human Blood Agar as Substitute for Sheep Blood Agar in Laboratories of Developing Countries…)			
		Write proposal on raring sheep for provision of the recommended blood for culture media			
Specimen collection, transport & management	No existing protocol related to sensitive specimen processing within one hour of reaching the laboratory	Revise the sample processing SOP for bacteriology specimen to include protocol related to sensitive specimen, rejection criteria, required collection modalities.			
	Lab and other departments did not provide annual refresher training to clinical staff on stool culture specimen collection	Develop the bacteriology sample collection and management material course to Incorporate in to CPD activities and in service trainings.			
		Conduct training on bacteriology sample collection and management	1st – 14th Jul 2024		Include in ten-day Training of health care provider (Drs, Nurse, IPC…)

Processing	After incubation of blood culture, subculture all bottles that appear negative on BA or CBA	Write SOP for standardized bacteriological testing based on sample type (blood, Urine. CSF, Stool…)	10th – 23rd Jun 2024		Include in ten-day workshop on QMS document development for microbiology
Basic AST	No in-use antibiotic disks and strips stored in a tightly sealed container with active desiccants? No desiccants change color as moisture levels increase	Write SOP on antibiotic disks storage.			
Safety	No annually risk assessment conducted	SOP for annual risk assessment of microbiology laboratory			